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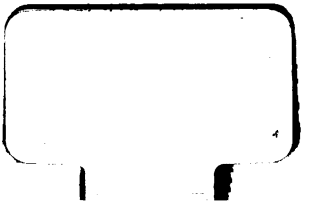
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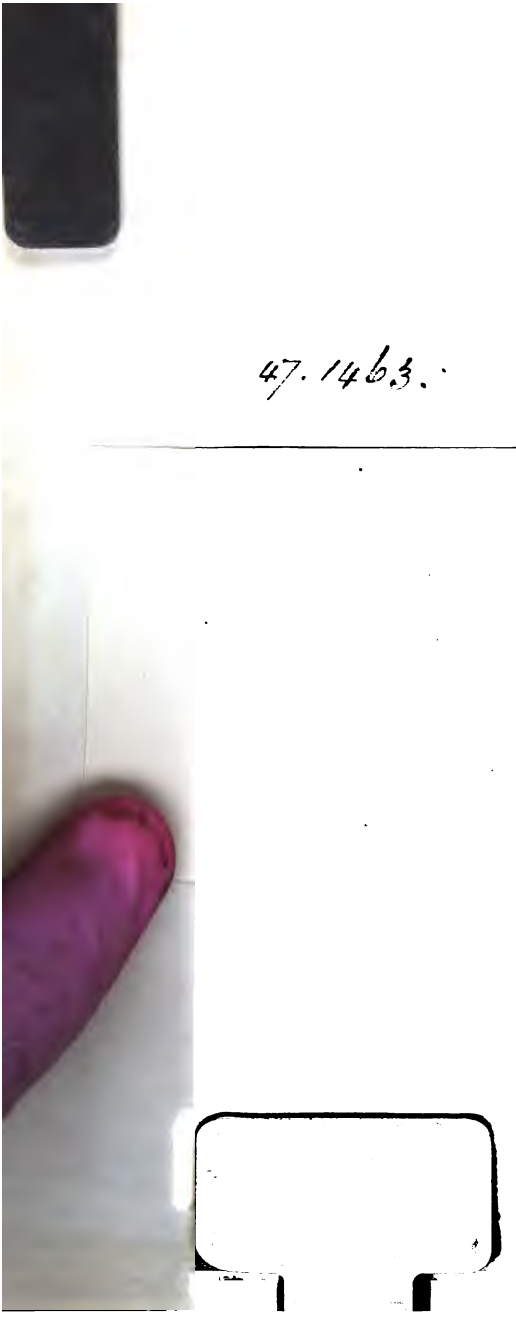
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INTRODUCTION

TO

LINEAL DRAWING

AND MENSURATION;

WITH HINTS ON THE ARRANGEMENT OF

DRAWING CLASSES.



By HENRY PICKTON.

"Drawing is of the greatest use in after life. It has the effect of leading to accurate habits of observation. It is a sovereign remedy for correcting idle habits; and of the greatest benefit to the scholar. It is indeed the most admirable adjunct to education."—LORD BROUGHAM.

LONDON:

DEPOSITORY OF THE BRITISH AND FOREIGN SCHOOL SOCIETY,
BOROUGH ROAD.

1847.

J. Rider, Printer, 14, Bartholomew Close, London.

PREFACE.

THE Art of Drawing, with its application to mechanics and architecture, is now generally admitted to form a necessary part of education for the children of the labouring classes.

The advantages attending this study are so numerous, and have been alluded to so frequently, as to require no arguments to induce every teacher to bestow some attention to its cultivation among his pupils.

The deficiency of the mass of our countrymen in a practical acquaintance with this art has been of late years diminished by the introduction into England of the excellent system of Model Drawing, taught so successfully at Exeter Hall by the lamented Mr. Butler Williams, under the sanction of the Committee of Council on Education. The system is now pursued in many of our Mechanics' Institutions, as well as in schools of a superior class.

The numerous merits of Mr. Williams's method are well known; and had every school in the kingdom sufficient time, and the pecuniary resources required for its successful introduction, any other exercises in drawing would be unnecessary.

The very limited period that the children remain in many public schools prevents, however, any great proficiency being made; especially as the present state of such schools demands the entire exertions and time of the teacher to the advancement of other studies.

It was not until repeated suggestions and many communications from those actually engaged in tuition were received, that the accompanying lessons on Lineal Drawing were compiled.

In accordance with these requests, it was determined to publish a few plain statements elucidating the introductory or elementary system of drawing as carried out in the Model Schools of the British and Foreign School Society; and it is not without a hope that some small benefit may arise, and some assistance be rendered, both to private students and also to the teachers and pupils in the various local schools throughout the country.

London, July, 1847.

INTRODUCTORY REMARKS.

INDEPENDENTLY of the intrinsic value of drawing as an art, it is scarcely less valuable as a mental exercise, inculcating habits of attention, accuracy, and precision.

Any teacher about introducing drawing into his school is recommended, therefore, to insist on perfect attention to his directions, and perfect accuracy in the details.

The earlier these habits are formed in the mind, the easier will every succeeding step be made; and there appears no valid reason why drawing should not be taught simultaneously with reading, or at least with writing.

In France, and some other continental countries, much attention is given to the art at a very early period of the pupil's life: and it seems scarcely possible to introduce too early some ideas of measurement, or some definite notion of the properties of figure.

To draw well, two things are necessary: first, the

cultivation of the eye; secondly, the cultivation of the hand. The first of these, I think, may be considered mental; the second is physical, and by far the more difficult: both will be improved by continued accurate labour; neither, if the work is allowed to be negligently executed, or the pupils hurried from exercise to exercise.

Thorough and critical inspection is also necessary; and here one or more of the most successful pupils can materially aid the teacher; for having performed each direction with fidelity, they can render their assistance to the more awkward or unsuccessful.

This will also tend to elevate the tone of the class, as all will strive to be singled out as the inspector of the others' productions.

The principal and perhaps the only novelty in the accompanying exercises, consists in their being eminently adapted for the children to use at their homes: for this purpose the illustrations are published separately, at a very low price, with a view to induce home work.

For private students the exercises may not be entirely useless. Drawing, or at least lineal drawing, is in a great degree a mechanical art, and skill in correct delineation may be acquired as well in the solitude of the closet as under the supervision of a teacher.

The usual plan of conducting classes in lineal drawing, and the one which for many years has been so successfully pursued in the schools in the

Borough Road, is this: The children are engaged in this exercise about half an hour daily. Each boy being provided with a piece of chalk, stands opposite a horizontal black board. The teacher at the head of the class either gives similar directions to those in the lessons, varying them according to circumstances; or exhibiting a sketch of the figure which he desires to be drawn, requires the pupils to copy it the exact size.

Both these methods are retained in the present exercises. In the first four the minds of the pupils are wholly directed by the teacher, the conceptive faculties principally.

In some of the succeeding lessons, the perception as well as the conception is engaged.

It is very desirable that a teacher should vary the exercises as much as possible; the book merely supplies a few hints and examples *how* to proceed —his own judgment and the success or failure of the class will probably induce him to omit or repeat many of the directions given.

Previous to the daily lesson, the exercise should have been well practised at home by the pupils; under these circumstances the improvement will be very considerable.

The children should at once commence drawing on black board and on paper. For practice on the latter, lead pencil is decidedly preferable to any other material. This is not recommended unadvisedly; one of the first artists and engravers of the

present day having satisfactorily shown the superiority of the lead pencil in imparting that freedom and ease to the hand which can be acquired in no other way.

It will be found too, that when some progress has been made, and some power gained in handling the pencil, other materials, such as the crayon and pen, may be used with much success. At the same time, for very bold drawing, or for classes utterly incompetent to represent a line with fidelity, chalk and black board will be found exceedingly useful; and the comparative economy of this arrangement is no inconsiderable argument in its favour. It is much to be regretted that great finish is incompatible with chalk drawing.

As far then as circumstances will permit, let the class be urged to use paper and pencil at their homes; to copy each exercise accurately on paper, enlarging it four times the size of the original; to bring their sketches on the following morning to the teacher or monitor of the class, who, having inspected the home exercise, should repeat it again and again until the children are able to execute it with truth and dispatch.

In many cases, the children will be prevented making any outlay beyond the mere copies: such can practise at their homes with chalk solely—the pavement of their yards supplying them with a substitute for a black board or paper.

If these few directions are fully carried out, experience has proved that one half-hour given to draw-

ing daily during school hours, with an additional one bestowed by the children at their homes, (which would probably be otherwise wasted or lost,) will, at the completion of three months, enable a pupil to make such progress in the art as materially to assist him in copying mechanical and architectural draughts of considerable difficulty.

Success, from the fourth to the fifteenth lessons inclusive, depends greatly on the pupil's possessing a clear notion of the geometrical and other figures there introduced.

It has frequently been found an almost impracticable task to convey (especially to the minds of young children) a distinct perception of those somewhat irregular geometric forms with which they have not been familiarized by observation or frequent recurrence.

A vague idea of any subject being very injurious, the teacher should strive, in every legitimate way, to fix on the mind the properties and forms of the more complex figures.

For this purpose, it is suggested that an accurate sketch, sufficiently large to be clearly seen by the class, should be made of the quadrilateral figures, polygons, &c., which scarcely admit of oral elucidation: appeal being thus made to a second sense—that of sight, little difficulty will be experienced in imparting a tolerably distinct knowledge, even to the most dull and unskilful student.

The teacher is recommended to use ruler and

compass for his own diagrams. Mathematical accuracy should be observed in copies at all times, as manifest injury must arise from an imperfect or slovenly model being presented to the class.

Of course no ruler or measuring instrument of any description is to be used by the pupils.

It is hoped that discouragement will not arise from one portion of the class making greater progress than another: this is experienced in every study. By assiduous attention, however, the less skilful will be urged on to compete successfully with their more able classmates.

At the termination of the first portion of the present course, when the class has shown decided ability in representing all the geometrical figures therein delineated, and also when ready and correct replies are given to the interrogatories of the teacher, the second portion of the lessons should receive some attention. A few observations respecting these are there prefixed.

The children in the classes in the Borough Road, having spent some time in the practice of the lineal drawing course, pass to other classes, where paper is employed to a greater extent, and the work finished with mathematical accuracy.

One portion of the class proceed to the study of architectural drawing—to the copy of plans, designs, elevations, or the five orders of architecture.

Another portion to mechanical drawing—machinery of different kinds; the uses and construction of which

are fully elucidated and explained, by constant reference to the pupil's own sketch.

To model drawing much attention is paid; and, with the previous practice they have had, the children are enabled to represent, with the most truthful accuracy, any of Mr. Williams's complete series of models.

But it must be borne in mind, that success in all these various undertakings, like stability in a building, depends entirely on a firm foundation being laid: careful attention should be paid to this. Sound results attend well-directed efforts; and the patient and persevering teacher is sure to be rewarded by the improvement and ultimate success of those who are placed under his care, and for the proper cultivation of whose minds and talents he may be considered responsible.

FIRST LESSON.

(Each of the Definitions should be illustrated by the Teacher.)

1. A line is the union of two points.

2. A straight or right line lies evenly between its extremities, and is the shortest distance between two points.

3. Right lines are either horizontal, perpendicular, or oblique.

4. A horizontal line has its extremities on a level.

5. A perpendicular line has one extremity exactly under the other.

6. An oblique line slants to the right or left.

7. Parallel lines are equi-distant from each other; and, if produced, would never meet.

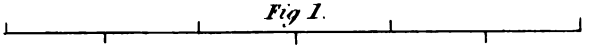
EXERCISES.

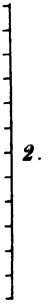
Look round the room, and point to some horizontal lines. Perpendicular. Oblique. Parallel lines. Draw a horizontal line. A perpendicular. An oblique line. Two parallel lines. Draw a horizontal line, 12 inches long. Divide it into three equal parts. Into six equal parts. Into twelve equal parts. (*Fig.* 1.) State the length of each part. Point to something in the room about 12 inches long. Two feet long. Six feet long. Draw a perpendicular line 6 inches in length. Divide it into twelve equal parts. (*Fig.* 2.) Length of each division? Draw an oblique line 9 inches long. Divide it into two parts. Length of each division? Into four parts. Length of each? (*Fig.* 3.) Draw four parallel horizontal lines, 2 inches apart and 12 inches long. Divide the upper into twelve equal parts—the second into six—the third into four, and the fourth into two parts. (*Fig.* 4.) Length of each? Draw six parallel perpendicular lines, of the respective lengths of 12, 10, 8, 6, 4, and 2 inches. (*Fig.* 5.) Relative proportion of second line to sixth —first to fourth, &c. &c.? Draw two oblique lines, 6 inches long, and 4 inches apart. (*Fig.* 6.) Draw four oblique lines, 12 inches long and 1 inch apart. Divide the first into twenty-four parts, and each succeeding one into six parts less. (*Fig.* 7.) Length of each part?

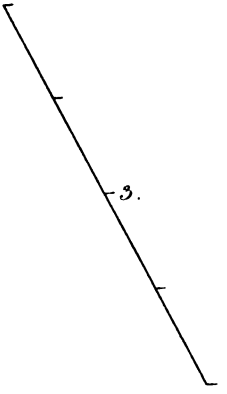
See Appendix, A.

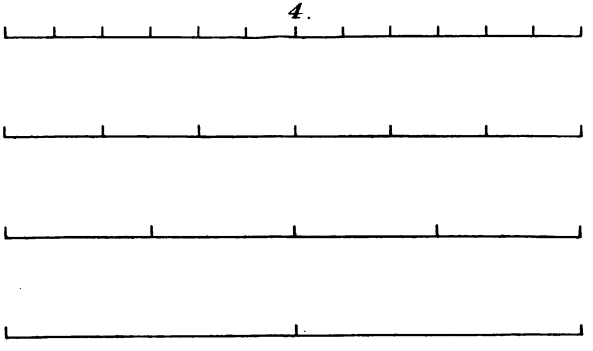
FIRST LESSON.

Fig 1.









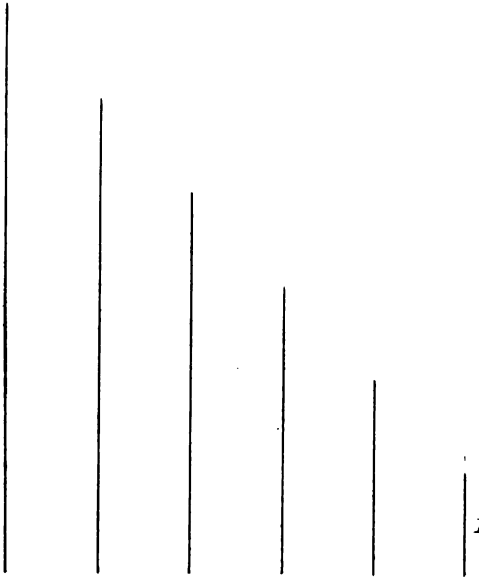
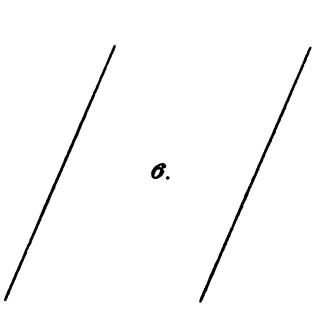
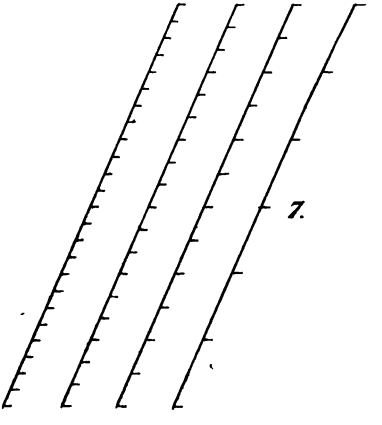


Fig 5.



6.



7.

SECOND LESSON.

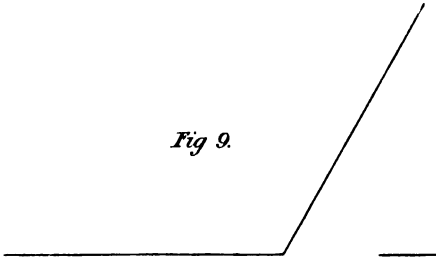
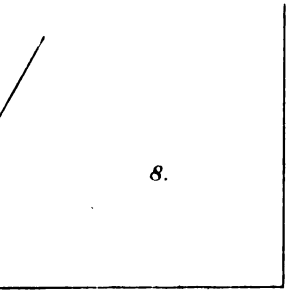
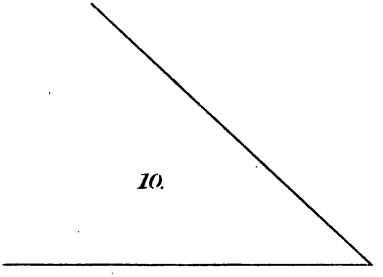


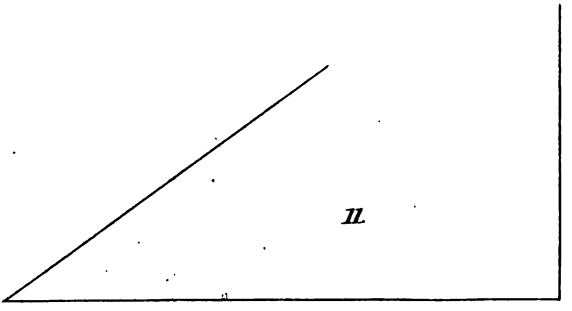
Fig 9.



8.



10.



11.

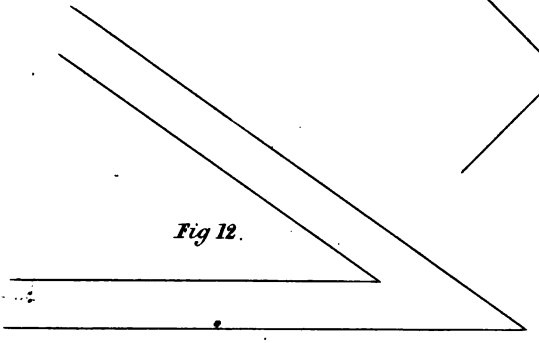
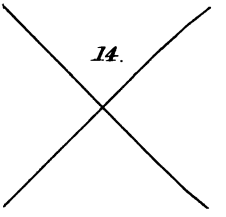
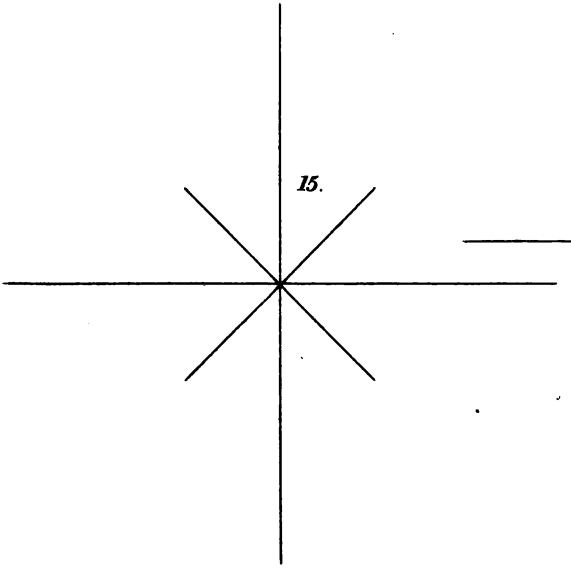


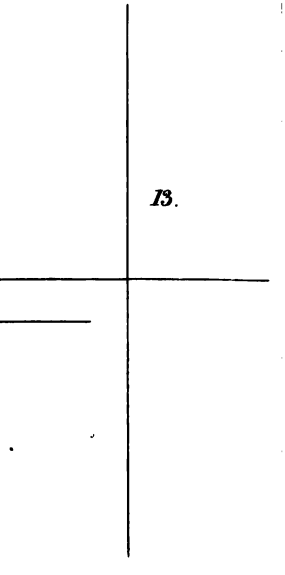
Fig 12.



14.



15.



13.

SECOND LESSON.

(Each of the Definitions should be illustrated by the Teacher.)

1. An angle is the corner formed by the union of two lines proceeding in different directions.
2. Rectilinear angles are formed by right lines.
3. Rectilinear angles are either right, obtuse, or acute.
4. A right angle is formed by one line falling on another perpendicularly.
5. An obtuse or blunt angle is greater than a right angle.
6. An acute or sharp angle is less than a right angle.

EXERCISES.

Look round the room, and show me a right angle. An obtuse. An acute. What angle does the lid of the slanting desk make with the table? The corner of the room with the ceiling, &c. &c.? Draw a right angle of 6 inch lines. (*Fig.* 8.) An obtuse angle same size. (*Fig.* 9.) An acute angle of 8 inch lines. (*Fig.* 10.) Draw a horizontal line any length; place a perpendicular at one end, and an oblique line running inwards at the other. (*Fig.* 11.) Angles thus formed? Draw a similar angle to those made by the walls and ceiling. A similar one to a ladder leaning against a wall. Explain it. Draw two acute angles, one within the other, 1 inch apart, the longer one of 12 inch lines. (*Fig.* 12.) Draw a 12 inch perpendicular, and a 6 inch horizontal, exactly intersecting. (*Fig.* 13.) Explain the angles. Draw a large angle in the form of a V. Explain it. Draw two oblique 6 inch lines cutting each other in the centre. (*Fig.* 14.) Number and kinds of angles? Repeat the two last exercises in one figure. (*Fig.* 15.) Analyse and explain the angles. Which is the larger, an acute angle formed of 20 inch lines, or a right angle of 6 inch lines?

See Appendix, B.

THIRD LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A square is a four-sided figure with all its sides equal and all its angles right angles.

2. An oblong, parallelogram, or rectangle, has its two opposite sides equal, and its angles right angles.

3. The area or superficies of a figure is the surface enclosed by the sides.

4. A diagonal is a line running from the opposite corner of a four-sided figure.

5. Figures with four sides are called quadrilateral.

EXERCISES.

What form is this room? These books? The window? The door? Point out a square. A parallelogram. Where would a diagonal be drawn across this room? Draw a diagonal across your board. Draw a 9 inch square. (*Fig.* 16.) Draw a rectangle 12 inches by 6. Divide it into two squares. Add diagonals. (*Fig.* 17.) Draw an 8 inch square. Add two diagonals, and a perpendicular, and horizontal line. (*Fig.* 18.) What angles made by these? Draw a rectangle 12 inches by 4 inches. Divide it into three squares. (*Fig.* 19.) Copy Exercise 20, making the squares 4, 3, 2, and 1 inch respectively. Copy Exercise 21, the same proportion as the last.

See Appendix, C.

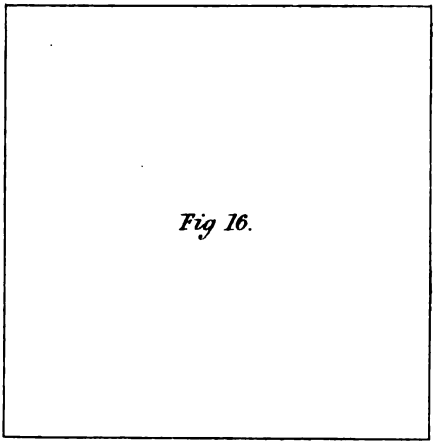
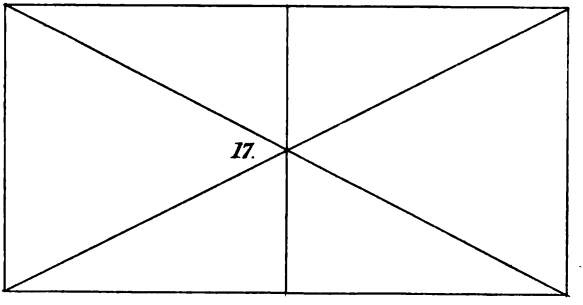
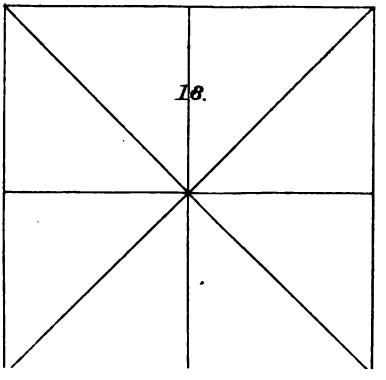


Fig 16.



17.



18.

THIRD LESSON.

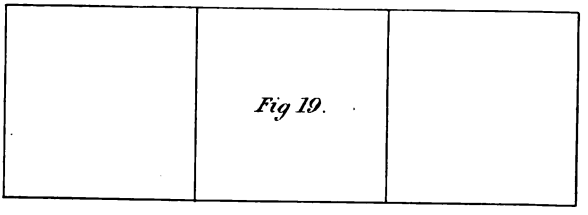
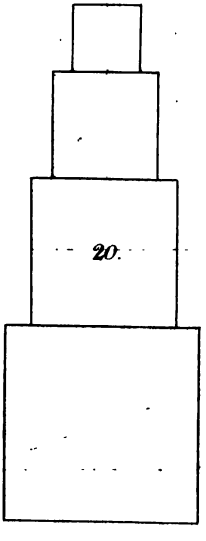
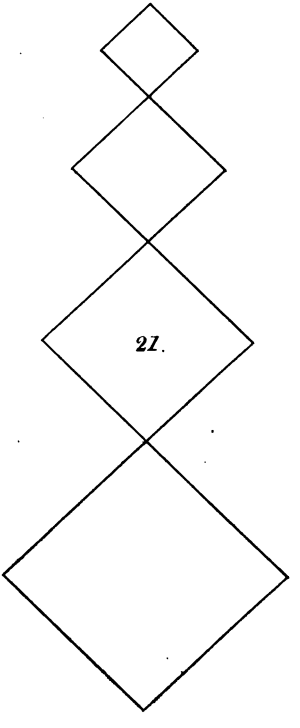


Fig 19.

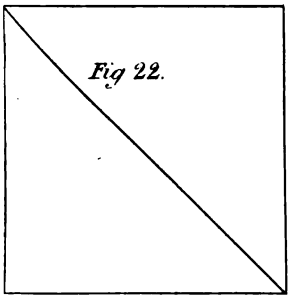


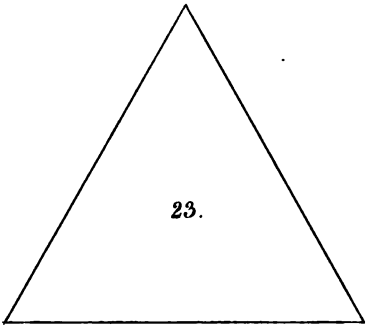
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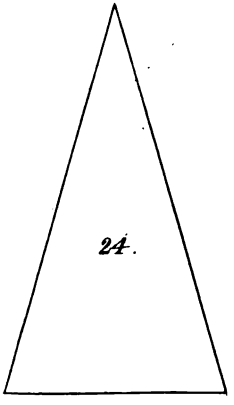


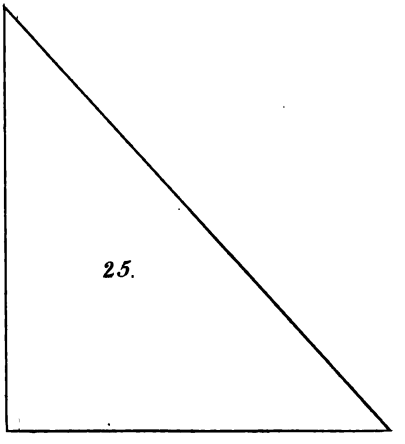
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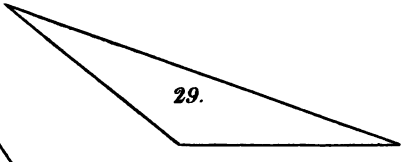
FOURTH LESSON.

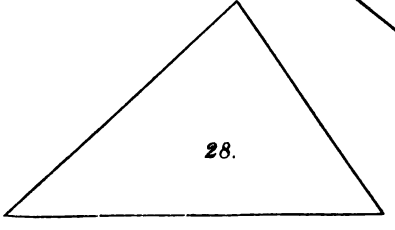












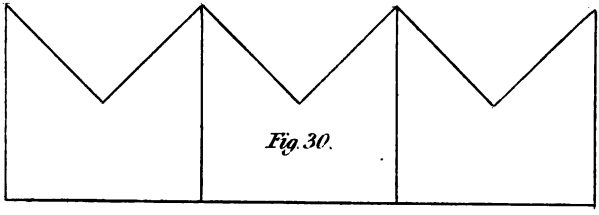
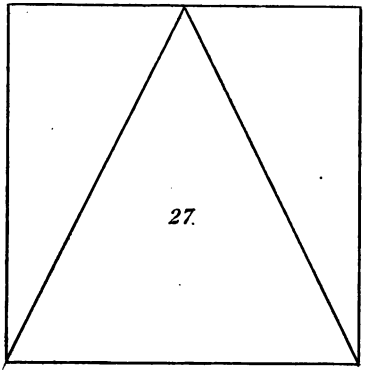
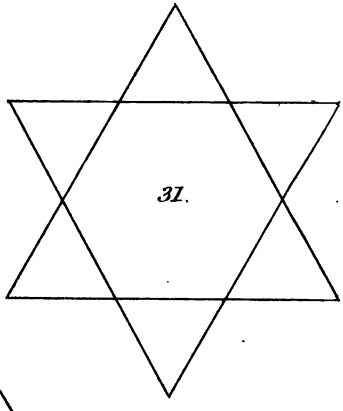


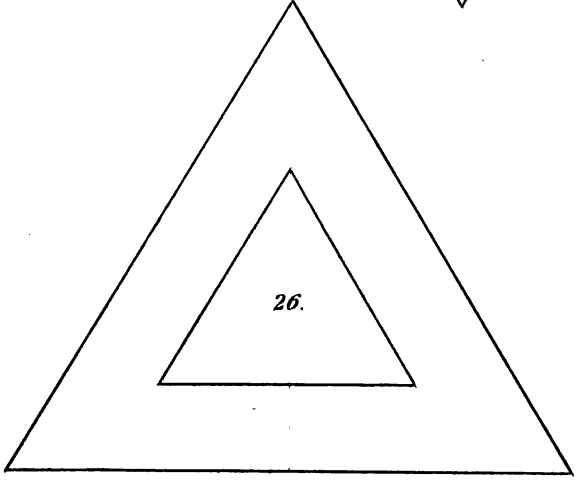
Fig. 30.



27.



31.



26.

FOURTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A triangle is a figure of three sides and three angles.

2. If the sides be equal, the triangle is termed equilateral.

3. If two sides only are equal, it is termed isosceles.

4. If all are unequal, it is called scalene.

5. A right-angled triangle contains a right angle; the hypothenuse is the line connecting its extremities.

6. An obtuse-angled triangle contains an obtuse angle.

7. An acute-angled triangle contains an acute angle.

8. The vertex of a triangle is its highest point.

EXERCISES.

Point to a triangle in this room. Draw a 6 inch square. Divide it into triangles. (*Fig.* 22.) State their kind. Draw an equilateral triangle with 8 inch sides. (*Fig.* 23.) An isosceles triangle any size. (*Fig.* 24.) A scalene triangle. (*Fig.* 25.) Draw two equilateral triangles, one within the other; the outer one with 12 inch sides, the inner one with 6 inch sides. (*Fig.* 26.) Draw a square 8 inches wide. On its base construct a triangle. (*Fig.* 27.) State what kind of triangle is formed. Draw an acute-angled triangle. (*Fig.* 28.) An obtuse-angled triangle. (*Fig.* 29.) Copy Exercise 30. Copy the Roman figure, Exercise 31. Explain each angle and triangle.

See Appendix, D.

FIFTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A rhombus is a parallelogram with equal sides, containing two acute angles and two obtuse angles opposite one another.

2. A rhomboid resembles a rhombus, but its opposite sides only are equal.

3. The perpendicular is a line crossing these figures, connecting the base with the top.

4. A trapezium is a quadrilateral figure with neither of its sides parallel.

5. A trapezoid is a figure with two of its opposite sides parallel.

6. A diagonal is the line joining the opposite angles of a quadrilateral figure.

EXERCISES.

What is meant by quadrilateral? Any quadrilateral figure in the room? Draw a 12 inch square. Substitute two oblique lines for the two perpendiculars. (*Fig.* 32.) What figure is thus formed? Draw a parallelogram 12 inches by 6. Proceed as in the last instance. (*Fig.* 33.) What is the figure? Draw a quadrilateral figure, of any size, with neither of its sides parallel. (*Fig.* 34.) What is such a figure called?

Draw a parallelogram 8 inches by 4. Substitute an oblique line for the upper horizontal line. (*Fig.* 35.) What figure is formed? Copy Exercise 36. Copy Exercise 37.

See Appendix, E.

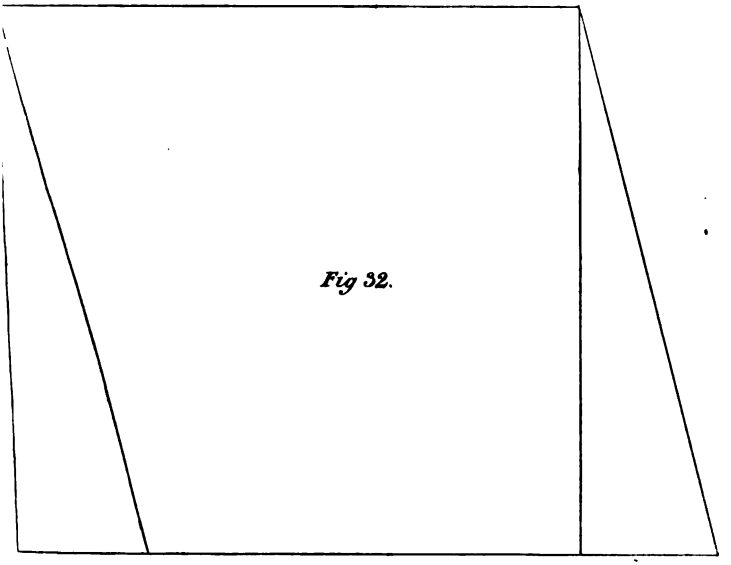
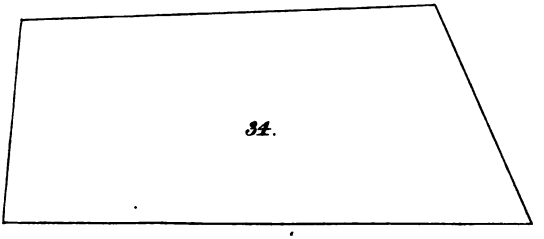
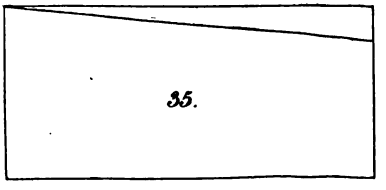


Fig 32.



34.



35.

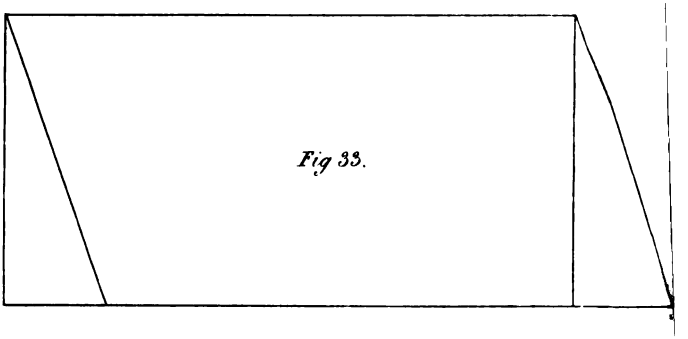
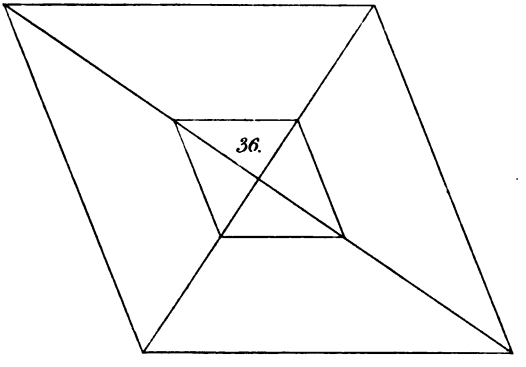
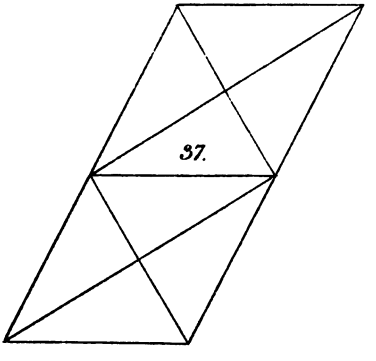


Fig 33.



36.



37.

SIXTH LESSON.

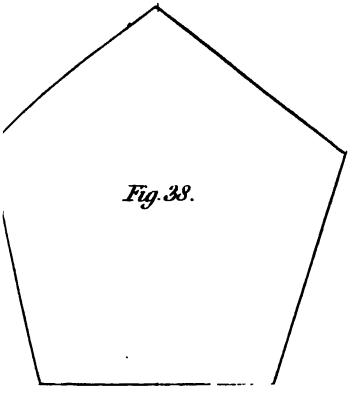
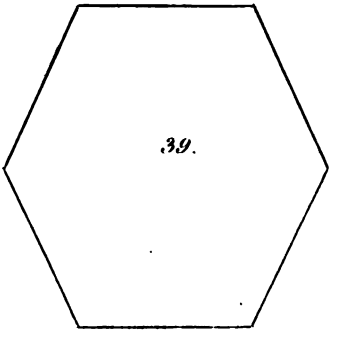
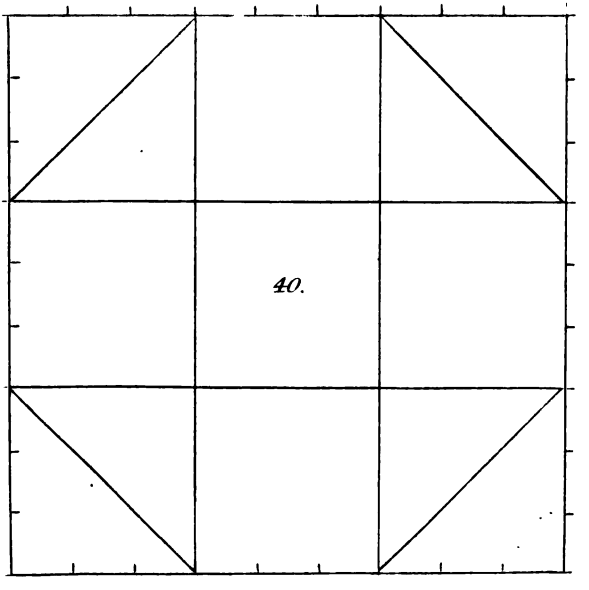


Fig. 38.



39.



40.

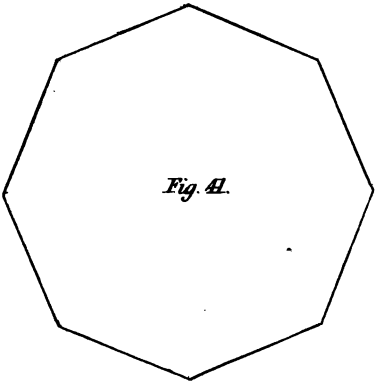
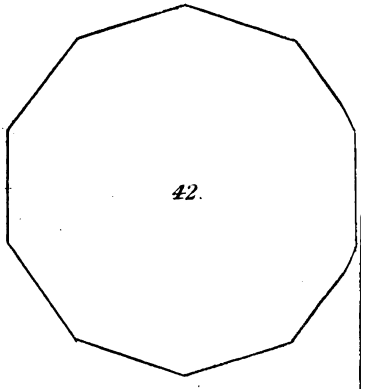
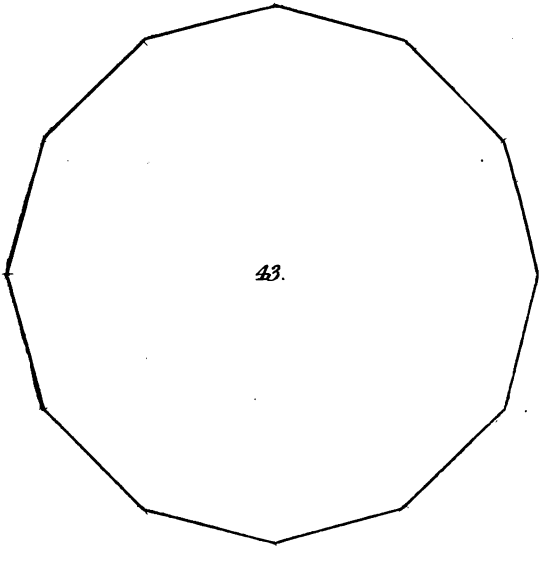


Fig. 41.



42.



43.

SIXTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A plane figure with four sides is called a quadrilateral figure: with more than four sides, a polygon.

2. A polygon may, therefore, have five, six, seven, or more sides.

3. A pentagon is a figure of five sides; a hexagon has six sides; a heptagon seven; an octagon eight; a nonagon nine; a decagon ten; an undecagon eleven; a duodecagon twelve sides.

4. Polygons are called regular when their sides are all equal; irregular, when they are unequal.

EXERCISES.

Point out some polygons in this room. What is a polygon of five sides called? Nine sides? Twelve sides? Six sides? Copy Exercise 38. What is it called? Describe all the angles it contains. Copy Exercise 39. Describe it. Draw a 12 inch square, and divide each side into inches. Rub out the extreme 4 inches of each line, and connect the extremities. Enclose parallelograms within it. (*Fig.* 40.) What figure is formed? Kind of octagon? Draw a regular octagon. (*Fig.* 41.) Draw a nonagon with 4 inch sides. Draw a decagon. (*Fig.* 42.) An undecagon. A duodecagon. (*Fig.* 43.)

See Appendix, F.

SEVENTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A curve is a part of a circle.

2. A curve is sometimes called an arc.

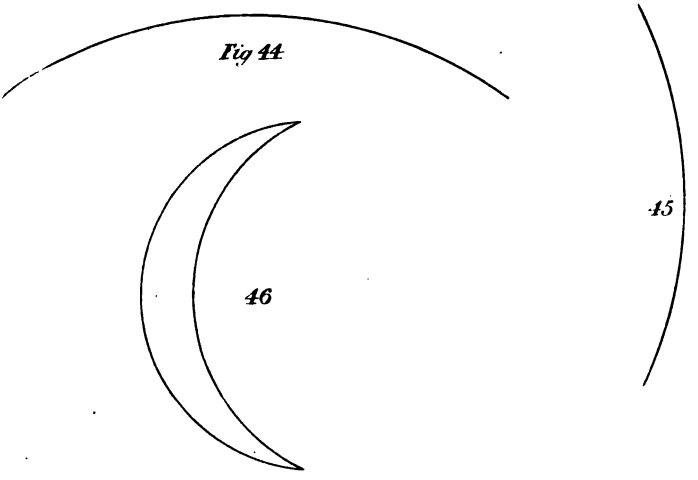
3. Any angle formed of curved lines is called curvilinear.

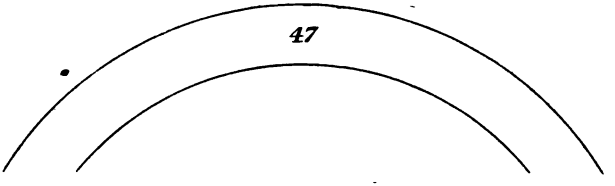
4. Parallel curve lines are those which remain at the same distance from each other.

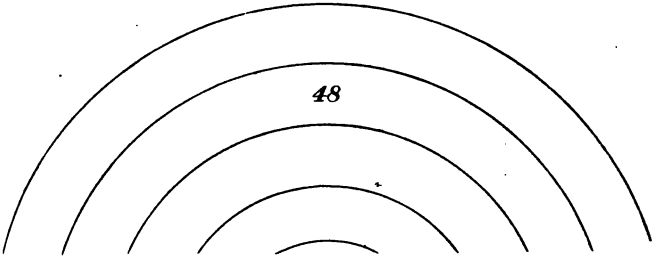
EXERCISES.

Look round the room, and point out some curved lines. A curvilinear angle. Parallel curved lines. Property of parallel lines? Another name for curve? Draw a curve upwards, with its extremities horizontal. (*Fig.* 44.) Draw a curve with its extremities perpendicular. (*Fig.* 45.) Copy Exercise 46. Draw two curves with their extremities horizontal. (*Fig.* 47.) Draw five curves in the same direction, one within the other. (*Fig.* 48.) Draw two curves in a similar direction, 1 inch apart. Divide each into twelve parts. Draw lines from the centre of the curves to the circumference, through the divisions. (*Fig.* 49.) Copy Exercise 50. Repeat the exercise five times, with the curves 2 inches apart. (*Fig.* 51.) Copy Exercise 52. Repeat five times, as before. Repeat the exercise, and place curve and perpendiculars alternately. (*Fig.* 53.) Draw two curves, meeting in the form of an S. (*Fig.* 54.)

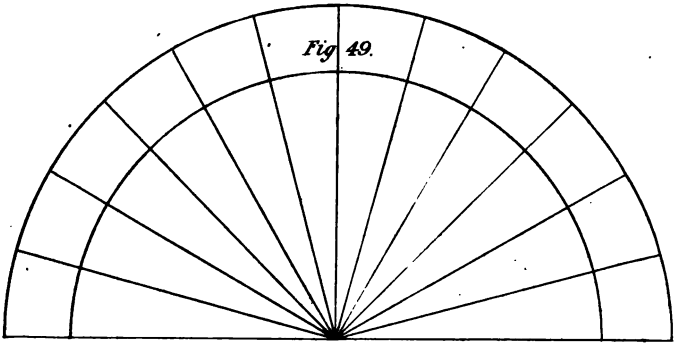
See Appendix, G.

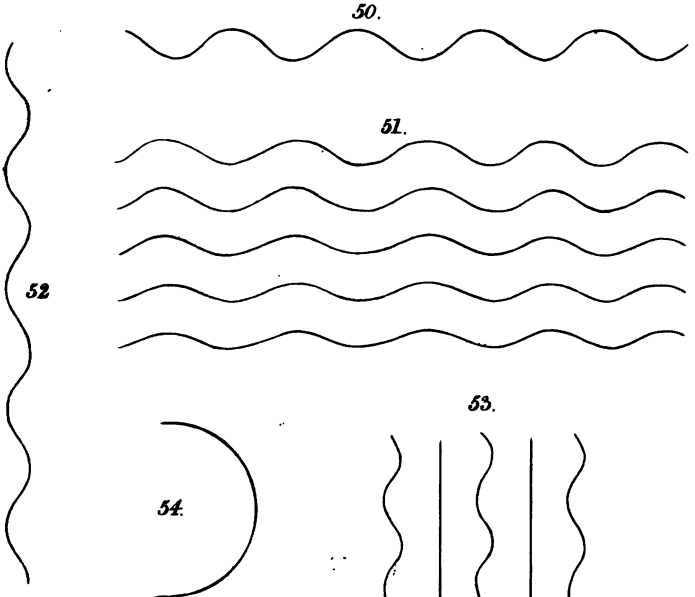

Fig 44
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48

SEVENTH LESSON.





EIGHTH LESSON.

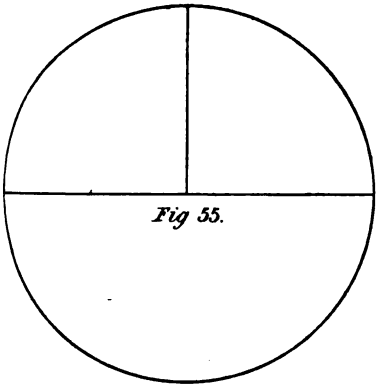
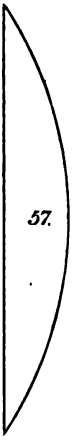
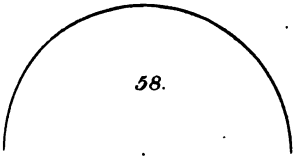


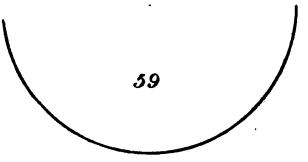
Fig 55.



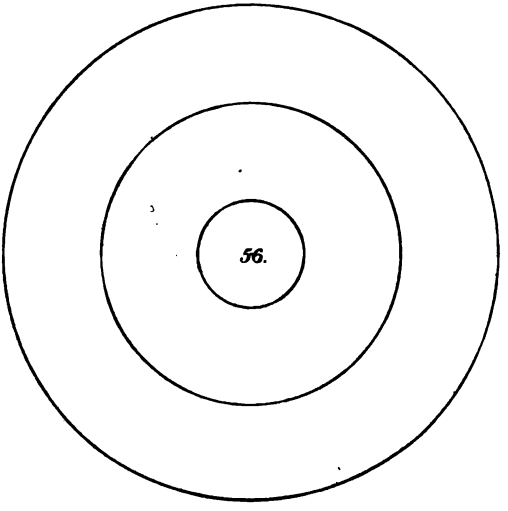
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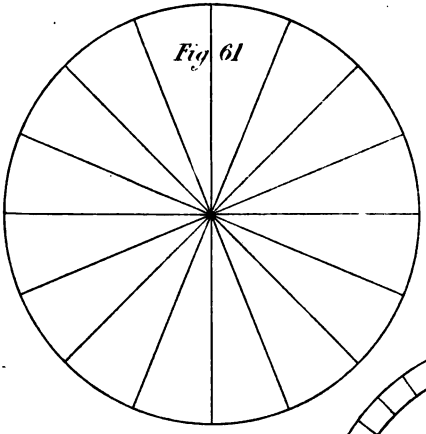
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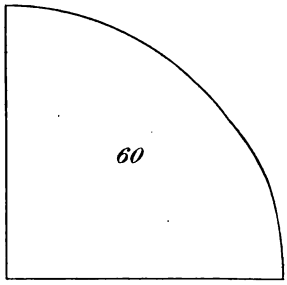


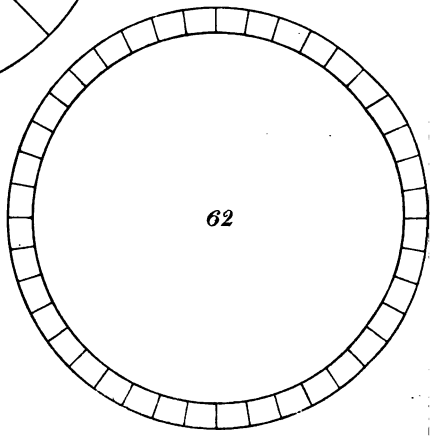
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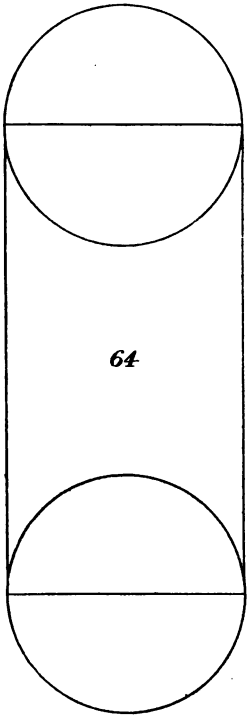


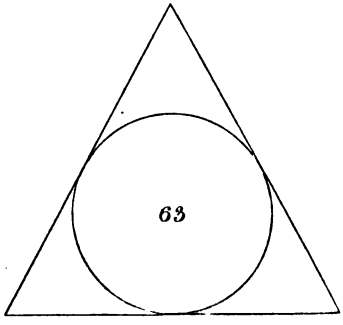
56.


Fig 61


60


62


64


63

EIGHTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. A circle is a figure bounded by a curved line, called the circumference, everywhere equi-distant from a point within it, termed the centre.

2. The diameter of a circle is a line drawn through the centre, touching the circumference on both sides.

3. The radius of a circle is half the diameter.

4. An arc is any part of a circumference.

5. A chord is a right line joining the extremities of an arc or curve.

6. A semicircle is half a circle.

7. A quadrant is the fourth part of a circle.

8. A segment is any part of a circle with the chord.

9. A sector is an arc with two radii.

EXERCISES.

Look round the room, and point out some circles. Draw a circle 8 inches wide. Place within it a diameter. A radius. (*Fig.* 55.) Draw three circles, one within the other, 2 inches apart; the innermost one 2 inches in diameter. (*Fig.* 56.) Draw an arc with its chord. (*Fig.* 57.) Draw an exact semicircle upwards. (*Fig.* 58.) Draw a semicircle downwards. (*Fig.* 59.) Draw a quadrant of a circle, 12 inches in diameter, having two radii. (*Fig.* 60.) Angle thus formed? Draw a 9 inch circle, with eight diameters. (*Fig.* 61.) Draw a 9 inch circle enclosing an 8 inch circle. Divide each into forty parts, and connect lines. (*Fig.* 62.) Enclose a 4 inch circle in a triangle. (*Fig.* 63.) Draw a parallelogram, 10 inches by 6 inches. Add a circle at each end. (*Fig.* 64.)

See Appendix, H.

NINTH LESSON.

DEFINITIONS.

(Illustrate on black board.)

1. An ellipse is a figure bounded by a curved line, as a circle; but having one diameter greater than the other.

2. The longer diameter is termed the transverse diameter or axis; the shorter, the conjugate diameter or axis.

3. An oval is a kind of ellipse, with one end narrower than the other.

4. A circle viewed sideways appears an ellipse.

EXERCISES.

Point out some examples of an ellipse. Of an oval. What form is an egg? Draw an ellipse 12 inches by 8 inches. (*Fig.* 64.) Add the diameter, and describe them. Draw an ellipse 9 inches by 6 inches. Add the diameter, and join their extremities by right lines. (*Fig.* 65.) Draw an ellipse 9 inches by 6 inches, standing perpendicularly. Draw a rectangle 12 inches by 6 inches. Add an ellipse to each end. Raise a perpendicular in the middle, and draw a third ellipse. (*Fig.* 66.) When does a circle appear as an ellipse? When does an ellipse appear as a circle, &c. &c.

See Appendix, I.

NINTH LESSON.

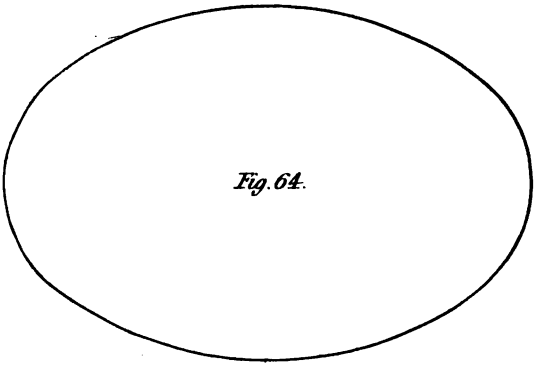
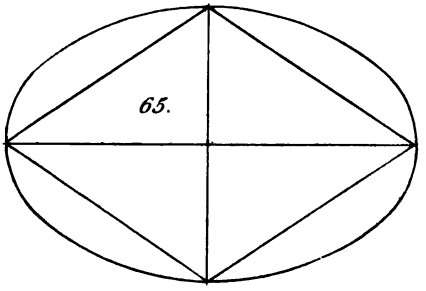
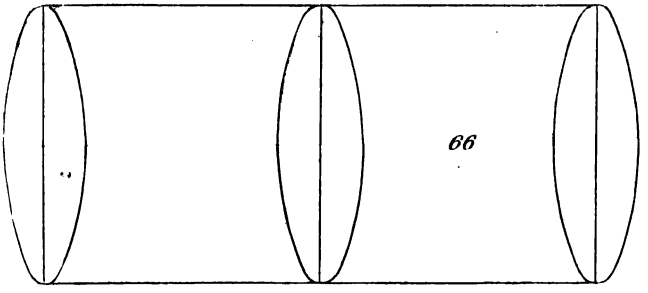


Fig. 64.



65.



66

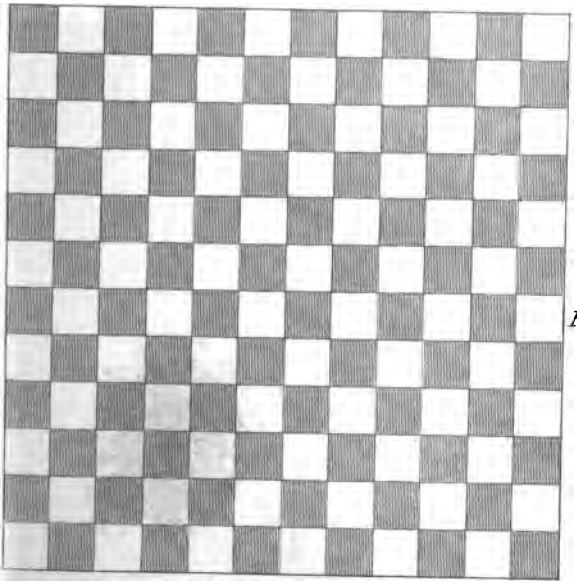
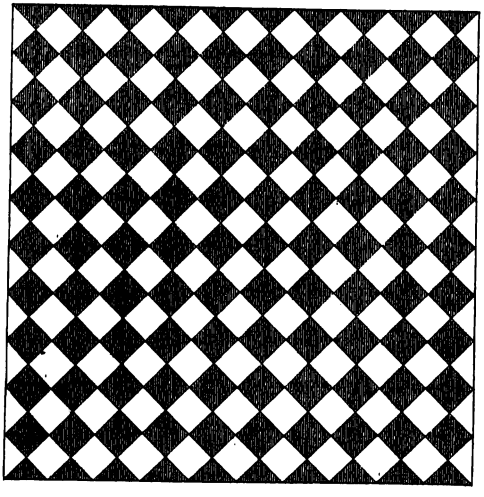
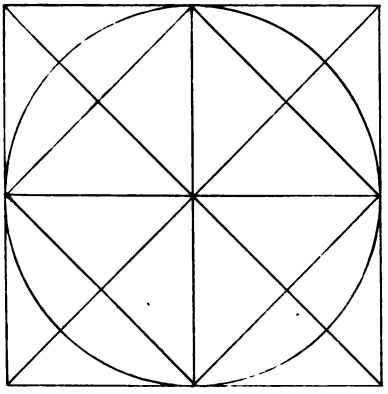


Fig 67.

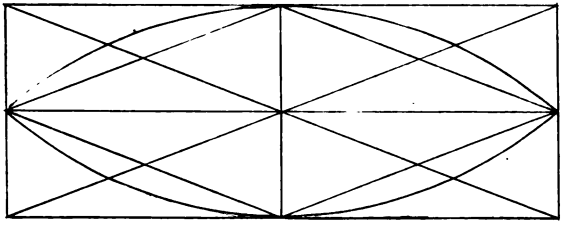


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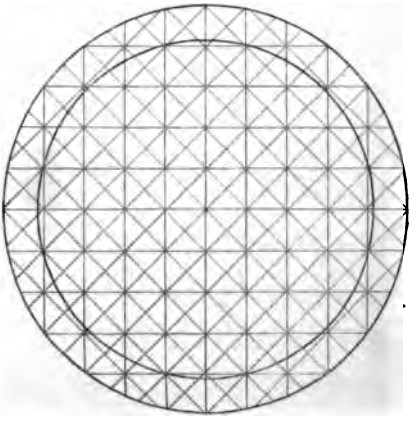
Fig 69.



70.



71.



TENTH LESSON.

RECAPITULATORY EXERCISE.

Describe the different kinds of angles. Triangles. Quadrilateral figures. Polygons. When are they termed regular? Irregular? Describe a circle. An arc. A quadrant. An ellipse. Draw a 12 inch square. Enclose sixty-four squares within it. Fill up with your pencil or chalk every alternate square. (*Fig.* 67.) Draw a 10 inch square. Divide each side into ten parts. Connect the divisions by diagonals, and shade as before. (*Fig.* 68.) Draw an ellipse as large as your board. A circle. Two 10 inch circles adjoining. A square in a circle. A circle in a square. Add diagonals. Add two diameters. Enclose a third square within the circle. (*Fig.* 69.) Draw a triangle in a circle. A circle in a triangle. Draw an ellipse. Divide the circumference into twenty equal parts. Connect lines with the centre. Alter the ellipse into an oval. Add diameters, and state their names. Draw a rectangle 12 inches by 5 inches. Add diagonals, and a perpendicular and horizontal. Connect the extremities of the latter. Enclose an ellipse. (*Fig.* 70.) Explain all the angles in the figure.

Draw an 8 inch circle. Enclose a 7 inch circle. Add nine perpendiculars. Nine horizontals. And eighteen lines crossing obliquely; thus dividing the figure into triangles. (*Fig.* 71.)

Similar questions may be asked, and the Exercise extended.

PART SECOND.

INTRODUCTION

TO THE

SUCCEEDING LESSONS.

THE preceding Exercises will occupy considerable time to be executed with accuracy and neatness.

At the termination of the first course, five additional lessons are appended, merely as specimens, to explain still further the plan usually adopted in applying lineal drawing to a practical purpose.

One branch only is noticed, viz., its application to building work; other subjects equally important might successfully engage attention, such as mechanics, or machinery; the theory and principles of perspective, or of conic sections.

It will be seen that any *course* of instruction in so limited a space is entirely impracticable, and the subject is merely introduced to supply a few hints, which time and research, or at least a little ingenuity, will enable a teacher to extend.

It is hoped that at a future period the subject

may be considered de novo, and an elementary work prepared on a regular system.

A great benefit would arise by obtaining models and specimens of the different forms of mouldings, or the various parts of a door or column referred to in the lessons—thus accustoming the children to those forms which to many of them will be every-day companions in after life.

Technicalities have by no means been avoided, nor was it thought desirable nor even practicable so to do. The names of the different parts of a building can of course be substituted by no others.

There will be found little difficulty in fixing these technical terms on the memory. The familiarity of the object, and its exceedingly frequent recurrence, will do much to call up in the mind the correct names by which its various parts are designated.

The private student, more desirous to gain power and skill in drawing, than any acquaintance with the succeeding representations, will do well to consult the excellent series of designs entitled "Cours de Dessein Linéaire, par Lamotte." *

But to the mass of those who have employed the preceding illustrations it is hoped that the following will supply a long-felt deficiency; works on such subjects being usually far too voluminous and expensive to be within the reach of those engaged in elementary tuition.

* Published by Bailliere, Regent-street.

To such as are disposed to carry the subject to a greater extent, I would recommend some attention to Nicholson's "Builder and Architect's Guide."

The first lesson introduces the different kinds of mouldings; the second, the various parts and proportions in a door; the third, a roof; and the fourth and fifth, the details and proportions of a Tuscan column.

This outline can easily be extended, by enlarging on the different *kinds* of roofs, doors, columns, &c.

In order that no inaccuracy may have crept in, the whole of the second part has undergone the inspection and revision of a practical builder, a gentleman eminent in his profession, to whom, as well as to the authors of the different works I have consulted, I take this opportunity of tendering my respectful acknowledgments.

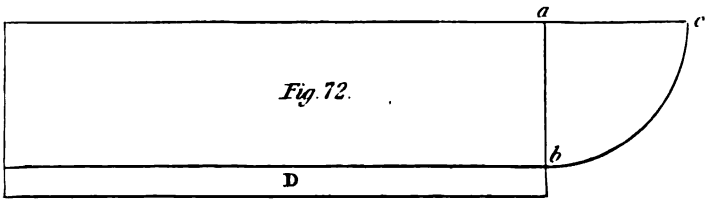
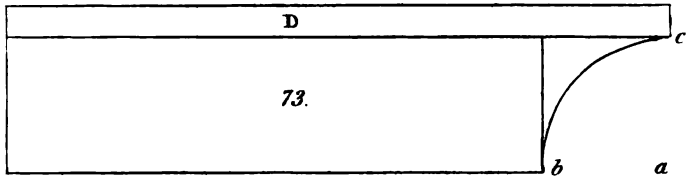
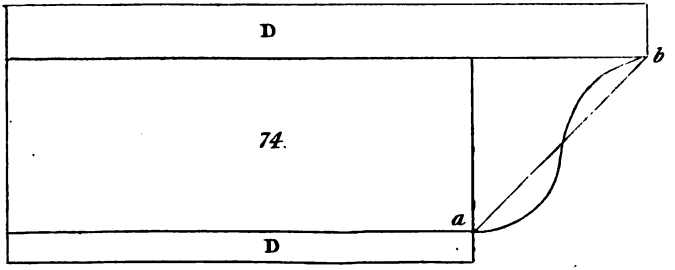


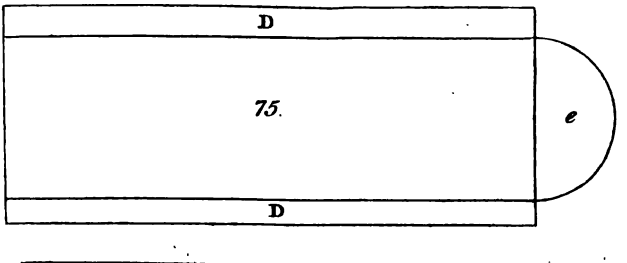
Fig. 72.



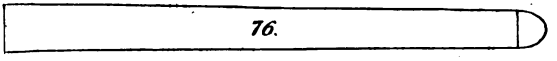
73.



74.



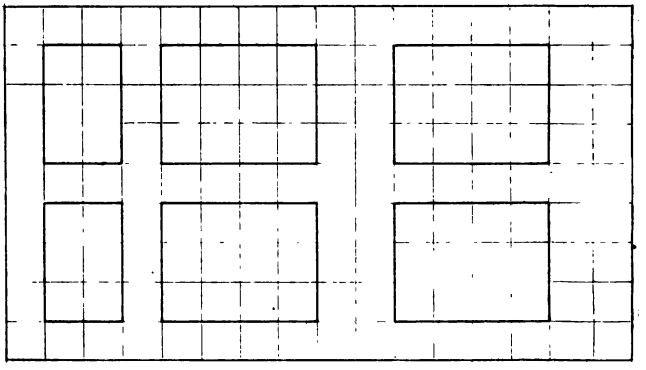
75.



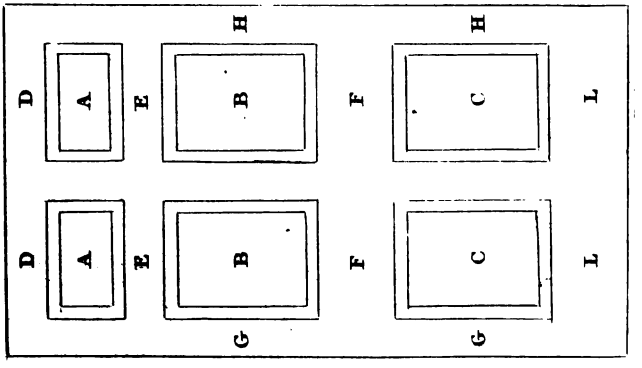
76.

TWELFTH LESSON.

Fig 78.



79.



ELEVENTH LESSON.

DEFINITIONS.

(Illustrate on black board, and with models.)

1. A moulding is a projection from a wall, column, or other plane surface. Mouldings may be either square or round, straight or crooked, convex, concave, or mixed.

2. An ovolo is the most common form of moulding, formed by a quadrant of a circle terminating a parallelogram. (*See Fig.* 72.)

3. A cavetto is concave, formed of a reversed quadrant terminating a parallelogram. (*Fig.* 73.)

4. A cima recta is formed of a cavetto and ovolo joining one another. (*Fig.* 74.)

5. A torus is a moulding with a semicircular convex end, generally found in the base of a column. (*Fig.* 75.)

6. A bead is a moulding formed of part of a circle, (usually a half,) introduced to remove the unsightly appearance of joints. (*Fig.* 76.)

7. A fillet is a small rectangle attached to an ovolo, cavetto, or cima recta. A fillet added to a bead forms a torus.

EXERCISES.

Look round the room and point out an ovolo. A cavetto. A cima recta. A torus. A bead. A fillet. Describe each. Draw a rectangle 12 inches by 3 inches. Add a quadrant at one end. Draw a narrow parallelogram beneath it. (*Fig.* 72.) Moulding formed? Repeat the last exercise. Add a concave curve. (*Fig.* 73.) Moulding formed? Copy Exercise 74. Name of moulding? Copy Exercise 75. Name of moulding? Where found? Copy Exercise 76.

The teacher is requested to note that the representations are *sections* of mouldings.

See Appendix, K.

TWELFTH LESSON.

PARTS OF A DOOR.

DEFINITIONS.

(Illustrated with black board and models.)

1. The parts of a door are termed respectively panels, rails, and stiles.

2. The panels are the square or rectangular pieces in a door, which are enclosed in the marginal parts (A A. B B. C C). (*Fig.* 81.)

3. The rails are the horizontal pieces between the panels (D D. E E. F F).

4. The stiles are the perpendicular pieces forming the outer margins of the door (G G. H H).

5. The rails are called respectively the top rails (D D), the frieze rails (E E), the middle rails (F F), and the bottom rails (L L).

6. The panels are called top (A A), middle (B B), and bottom (C C).

7. The perpendicular margin between the panels is called a muntin.

EXERCISES.

Mention the various parts of a door. Where are the stiles? What are they called? The panels? How are they distinguished? Where are the rails? How are they called? Draw a rectangle. Divide the length into 14 parts, and the width into 7 parts. Draw cross lines as in Exercise 80. Thicken the bounding lines of the panel, and efface the remainder. Copy Exercise 81. Point out the middle rail. The frieze rail. The outside stile. The top panel. The middle panel. The bottom rail. Which may be considered the framework of the door? Which is the weakest part of a door? Which is the muntin?

See Appendix, L.

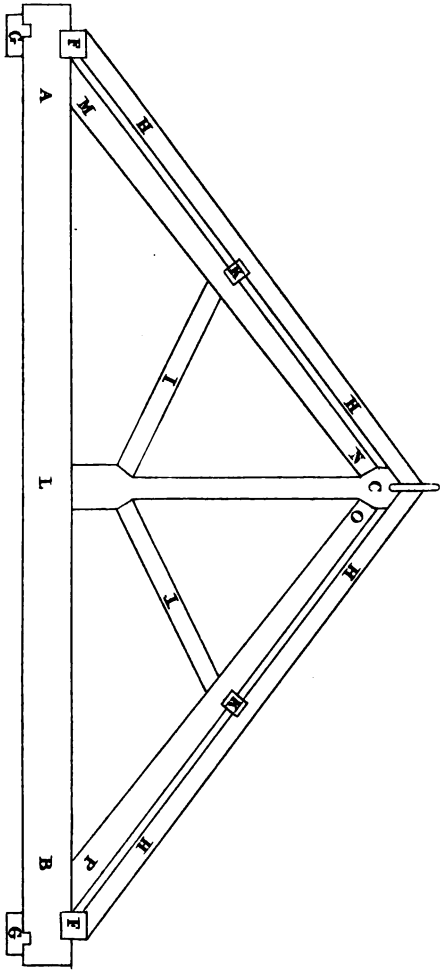
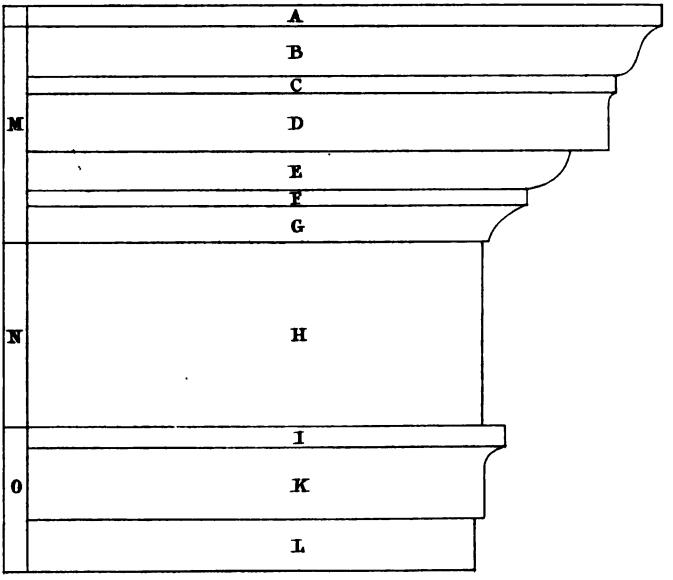


Fig 80.

FOURTEENTH LESSON.

Fig 81.



THIRTEENTH LESSON.

ROOFS.

Roofs are of various forms, according to the shape of the building; their size and strength are determined according to the width of the building, and the amount of support required.

The most common form of roof is represented in *Fig.* 80: such an one is calculated to sustain a moderate weight, and is adapted for a square or rectangular building.

DEFINITIONS AND DESCRIPTION.

1. The main timbers in a king post roof are the king post (C L); the tie beam (A B); and the principal rafters (M N O P). The king post is always vertical; the tie beam horizontal; and the rafters oblique: the whole together is called a principal, and on this the whole weight of the roof depends.

2. The principal rafters are strengthened by two oblique timbers, termed *braces* (I I).

3. The ends of the *principal rafters* (M N O P) are inserted or *morticed* in the extremities of the king post and tie beam.

4. The *wall plates* (G G) connect the roof with the brickwork.

5. The common rafters rest on the *pole plates* (F F), and *purlines* (K K).

6. The *purlines* (K K) are the timbers which run parallel to the sides of the building: their ends only are visible in the figure.

7. The small perpendicular piece at the apex is called the *ridge*, and runs parallel to the purlines.

8. The remainder of the wood work consists of *common rafters* (H H. H H).

EXERCISES.

Name all the timbers in a roof. Direction of king post? Tie beam? Position of ridge? Situation of pole plates. Wall plates. Their use? Where are the braces? Their use, &c., &c., &c.? Copy Exercise 80, enlarging it four times. Explain each part.

FOURTEENTH LESSON.

TUSCAN ENTABLATURE.

1. An entablature consists of the cornice, frieze, and architrave; and, for accuracy of detail, is divided into 105 parts, called minutes.*

2. The cornice (M), which includes 42 minutes, is divided into seven portions, called by the respective names introduced in Lesson 11. (See supra, page 25.)

3. The parts of a cornice have the following proportions:—

The fillet (A)	3	minutes.
Cima recta (B)	9½	„
Fillet (C)	2	„
Corona (D)	11½	„
Ovolo (E)	8	„
Fillet (F)	2	„
Cavetto (G)	6	„
	42	„

4. The frieze (N) is a plane surface 34 minutes in height.

5. The architrave (O) consists of the tenia (I), including 4 minutes; the upper facia (K), of 14 minutes; and the lower facia (L), of 11 minutes.

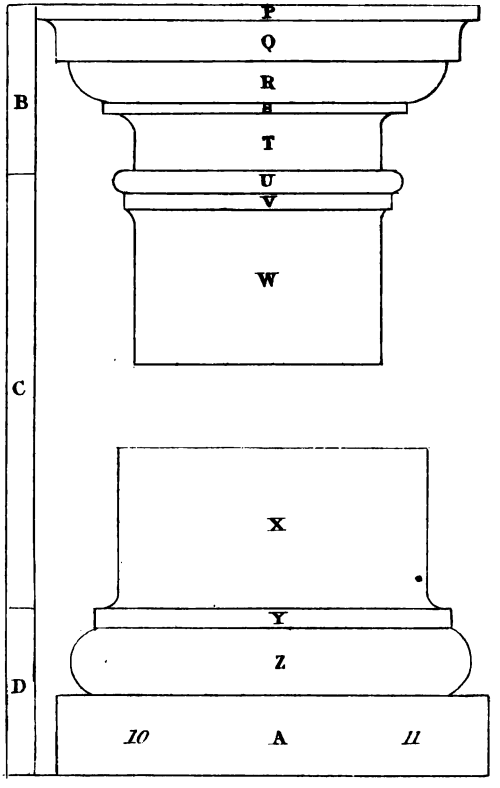
EXERCISES.

Describe an entablature. Where is it placed? How divided? Point out the cornice. The frieze. The architrave. How is the cornice divided? Proportion of upper fillet? Cima recta? Ovolo? Cavetto, &c. &c. &c.? Which part of an entablature is a plane surface? Proportion of frieze? Where is the architrave? Its proportion? Whole height of entablature? Copy Exercise 81. Write on each part its name and properties.

* A minute is one sixtieth part of the diameter of a column at the base.

FIFTEENTH LESSON.

Fig. 82.



FIFTEENTH LESSON.

TUSCAN COLUMN.

The Tuscan column is the simplest of the five orders of architecture; it is devoid of all ornament, and usually employed in buildings of the plainest kind.

1. A Tuscan column is divided into three parts: the capital, shaft, and base.

2. The capital (B) includes 30 minutes, and is divided into the

Fillet (P)	$2\frac{1}{2}$	minutes.
Facia (Q)	$7\frac{1}{2}$	„
Ovolo (R)	8	„
Fillet (S)	2	„
Neck (T)	10	„
	30	„

3. The upper fillet, together with the facia, is termed the abacus, and is the only square part of a Tuscan column.

4. The shaft (C) is 300 minutes in height, including the bead (U), of 4 minutes, and the fillet (V), of 2 minutes. The two latter portions together are termed the astragal.

5. The height of the column should be seven times its lower diameter.

6. The base (D) includes 30 minutes, and consists of a fillet (Y), 3 minutes; torus (Z), 12 minutes; and plinth (A), 15 minutes.

EXERCISES.

Character of Tuscan column. How divided? Point to each part. How is the capital divided? Proportion of ovolo? Fillet? Neck? Facia? &c. &c. Which forms the abacus? Where is the astragal? Trace each on your boards. Proportion of height of a column to its diameter? Proportion of base? Its parts? Show the plinth. The torus. The fillet. Proportion of each? Copy Exercise 82. Explain each part.

See Appendix, L.

IMPORTANCE OF CONNECTING THE STUDY OF GEOMETRY WITH THAT OF DRAWING.

THE study of drawing, as before observed, benefits the student in several respects; but when it is combined with that of geometry, the advantages are incalculably greater.

For the cultivation of the intellectual powers, there is in my opinion nothing to equal the mathematics; the perfect accuracy required in correct demonstration, and the impossibility of success attending desultory attention or superficial research, must induce habits of the most valuable and sterling character.

The following Appendix will be found to resolve itself almost entirely into two parts. In the first place, it refers to the theorems in Euclid which may be easily combined with the geometrical forms already drawn by the pupils.

The second part is added to give a brief outline of the method of teaching mensuration, principally the area of superficies deducible from the given sides.

Any edition of Euclid's Elements will supply the enunciation and demonstration of each proposition, and it is hoped that little difficulty will be experienced in drawing out from the class by induction the principal geometrical properties of every form.

A course of practical geometry, alternating with the lineal drawing lessons, would quite repay the teacher's labour, and form a good basis for a more extended course of imitative study.

The excellent treatise by Mr. Nesbit will supply fuller information in the mensuration of superficies or solids.

In conclusion, I would respectfully but earnestly express a hope, that this short course of lessons may prove of some slight service to teachers, and assist them in their arduous and important duties. I also hope that circumstances may enable me at some future period to undertake a more advanced series, which shall supply to a greater degree the requirements of the present progressive state of education.

APPENDIX.

(A.)

1. Two right lines cannot enclose a space.

2. If two right lines be parallel to the same right line, they are parallel to each other. (See EUCLID, Book I. Prop. XXX.)

(B.)

1. The size or span of an angle is estimated by the number of degrees it includes in a circle, of which the angle forms the centre.

If a circle be divided into 360 equal parts, and a right angle be placed in the centre within it, it is evident that such an angle includes 90 parts, and is therefore called an angle of 90 degrees—half a right angle is called an angle of 45 degrees, &c. &c.

2. If a right line stand upon another right line, and make angles with it, these angles are either two right angles or together equal to two right angles. (See EUCLID, Book I. Prop. XIII.)

3. If two right lines intersect one another, the vertical angles are equal. (See EUCLID, Book I. Prop. XV.)

(C.)

1. The opposite sides and angles of a parallelogram are equal. (See EUCLID, Book I. Prop. XXXIV.)

2. A parallelogram is bisected by its diagonal. (See EUCLID, Book I. Prop. XXXIV.)

3. A parallelogram is double a triangle, if it be on the same base and between the same parallels. (See EUCLID, Book I. Prop. XLI.)

MENSURATION.

Prob. I. To find the area of a square.

Rule. Multiply the length of one side by itself. The result is the required area.

Example. A square table has a side of 6 feet 6 inches: required its area.

feet.
Here 6·5
6·5
325
390
42·25
12
3·00

Ans. 42 feet, 3 inches.

Prob. II. To find the side of a square when the area is given.

Rule. Extract the square root of the area. The result is the required side.

Example. A court yard contains 1296 feet: required the length of its side.

Here $\sqrt{}$ 1296 feet = 36 feet. *Ans.*

Prob. III. To find the area of a parallelogram or rectangle.

Rule. Multiply the length by the breadth. The result is the required area.

Example. A dining-table is 15 feet 6 inches by 4 feet 3 inches: required its area.

feet.
Here 15 ·5
4·25
775
310
620
65·875
12
10·500
12
6·000

Ans. 65 feet, 10 inches, 6 pa.

Prob. IV. To find the other side when the area and one side is given.

Rule. Divide the area by the given side. The result is the required side.

Example. A marble slab 8 feet long, was found to contain a surface of 5760 inches: required its width.

Here 5760 ÷ by 96 inches = 60 inches, or 5 feet.

Ans. 5 feet.

Prob. V. To find the solid contents of a cube.

Rule. Multiply the height by the width, and that product by the height.

Example. A block of marble on measurement was found to be 10 feet long, 8 feet high, and 7 feet wide: required its solid contents.

Here 10 × 8 × 7 = 560 feet.

Prob. VI. To find the solid contents of a parallelopipedon.

Rule. Multiply the length by the width, and the product by the height.

Example. A rectangular stone pillar 25 feet 6 inches high, has a diameter of 15 inches: required the solid contents.

feet.

Here 25·5
1·25

1275
510
255

31·875
1·25

159375
63750
31875

39·84375
1728

675000
168750
590625
84375

1458·00000

Ans. 39 feet, 1458 inc.

(D.)

1. Three lines at least are required to enclose a space.

2. If two angles of a triangle are equal, the sides opposed to them are also equal. (See EUCLID, Book I. Prop. vi.)

3. If two triangles have all their sides respectively equal, then the angles contained by those sides are also equal. (See EUCLID, Book I. Prop. viii.)

4. Any two sides of a triangle taken together are greater than the third side. (See EUCLID, Book I. Prop. xx.)

5. Any two angles of a triangle are together less than two right angles. (See EUCLID, Book I. Prop. xxii.)

6. Triangles on the same base and between the same parallels are equal. (See EUCLID, Book I. Prop. xxxvii.)

7. If a parallelogram and a triangle be on the same base, the parallelogram is double of the triangle. (See EUCLID, Book I. Prop. xli.)

8. In a right-angled triangle, the square of the hypothenuse is equal to the sum of the squares of the sides. (See EUCLID, Book I. Prop. xlvii.)

MENSURATION.

Prob. VII. To find the hypothenuse of a right-angled triangle when the other two sides are given.

Rule. Add the square of one side to the square of the other, the square root of which sum is the required hypothenuse.

Example. A rectangular room 20 feet by 15 feet was divided by a diagonal partition: required the length of the partition.

Here $20^2 + 15^2 = 400 + 225 = 625$.

And $\sqrt{625} = 25$ feet, the length of the partition.

Prob. VIII. To find the area of a triangle when the base and perpendicular are given.

Rule. Multiply one dimension by half the other. The result is the required area.

Example. The height of one of the Egyptian pyramids is about 600 feet, and its base 690 feet: required the area of its 4 sides.

Here $\frac{600}{2} = 300 \times 690 = 207000 \times 4 = 828000$ feet.

Ans. 828000 feet.

Prob. IX. To find the area of a triangle when the three sides only are given.

Rule 1. Add the three sides, and take half the sum.

2. From the half sum subtract each side successively.

3. Multiply the half sum with the three remainders.

4. Take the square root.

Example. A churchyard of a triangular form was measured; the sides were found to be respectively 250 feet, 200 feet, and 150 feet: required the area.

$$\text{Here } \frac{(250 + 200 + 150)}{2} = 300$$

And $300 - 250 = 50$
$300 - 200 = 100$
$300 - 150 = 150$

Then $300 \times 50 \times 100 \times 150 = 225{,}000{,}000$ feet

$\sqrt{225{,}000{,}000} = 15{,}000$ feet, the required area.

Prob. X. To find the solid contents of a triangular pyramid.

Rule. First find the area of the base, multiply the sum by one-third the perpendicular height: the product will be the solid contents.

Example. A triangular pyramid 21 feet high has sides of 5, 6, and 7 feet respectively.

By *Prob.* IX. $5 + 6 + 7 \div 2 = 18 \div 2 = 9$

Then $9 - 5 = 4$
$9 - 6 = 3$
$9 - 7 = 2$

And $\sqrt{9 \times 4 \times 3 \times 2} = \sqrt{216} = 14{\cdot}696$

Then 14·696 feet $\times 7 = 102{\cdot}872$

Ans. 102·872 feet.

(E.)

1. The angles in a regular rhombus are respectively 60 and 120 degrees.

MENSURATION.

Prob. XI. To find the area of a rhombus or rhomboid.

Rule. Multiply the base by the perpendicular height. The product is the required area.

Example. The base of a square leaning tower was found to be 10 feet 5 inches, and its perpendicular height just 80 feet: required the area of one side.

	ft.	in.
Here	80	0
	10	5
	800	0
	33	4
	833	4

Ans. 833 feet, 4 inches.

Prob. XII. To find the area of a trapezium.

Rule. Divide the trapezium into two triangles, find the area of these by Prob. VII., the sum of which is the required area.

Prob. XIII. To find the area of a trapezoid.

Rule. Multiply half the sum of the parallel sides by the distance between them.

Example. A yard in the form of a trapezoid was measured; its parallel sides were found to be 12 feet and 10 feet, the distance 15 feet: required the area.

Here (12 ft. + 10 ft.) ÷ 2 = 22 ft. ÷ 2 = 11 ft.
And 11 ft. × 15 ft. = 165 ft., the required area.

(F.)

1. Constructing or assisting lines will be found exceedingly useful in the delineation of polygons; these will be supplied by the previous investigation of the teacher.

Thus a pentagon of 10 inches in height will have the following proportionate dimensions.

Extreme height	10 inches.
Extreme width	10 inches.
Upper part	4 inches.
Lower part	6 inches.
Base	6 inches.

Side in all cases, three-fifths of the total height.

MENSURATION.

Prob. XIV. To find the area of a polygon.

Rule. Multiply the square of the side by the integer and

decimals in the following table. The result is the required area.

Pentagon	1·7204774
Hexagon	2·5980762
Heptagon	3·6339124
Octagon	4·8284271
Nonagon	6·1818242
Decagon	7·6942088
Undecagon	9·3656399
Duodecagon	11·1961524

(G.)

1. Similar curves standing on equal right lines are equal. (See EUCLID, Book III. Prop. xxiv.)

(H.)

1. The proportion of the diameter of a circle to its circumference is as 7 to 22.

2. Concentric circles cannot meet, or if two circles cut one another they have not the same centre. (See EUCLID, Book III. Prop. v.)

3. One circle cannot intersect another in more than two points. (See EUCLID, Book III. Prop. x.)

4. In a circle equal right lines are equally distant from the centre. (See EUCLID, Book III. Prop. xiv.)

5. The diameter is the greatest right line in a circle, and of all others that which is nearest the centre is greater than the more remote. (See EUCLID, Book III. Prop. xv.)

MENSURATION.

Prob. XV. To find the area of a circle.

Rule. Multiply half the circumference by half the diameter: the result is the required area.

Or, Square the diameter and multiply by ·7854.

Or, Square the circumference and multiply by ·07958.

Example. A circular fish-pond measured 15 feet across: required the area.

Here ·7854 × by 15^2

225

39270
15708
15708

176·7150
12

8·5800
12

6·9600

Ans. 176 feet, 8 inches, 6 pa. +

Prob. XVI. To find the solid contents of a sphere.

Rule. Cube the diameter and multiply by ·5236.

Or, Cube the circumference and multiply by ·016887: the product will be the solidity.

Required the solidity of the planet Venus, whose diameter is about 7720 miles.

Here $7720^3 = 460099648000$

·5236

2760597888000
1380298944000
920199296000
2300498240000

Ans. 240908175692·8000 miles.

Prob. XVII. To find the solid contents of a circular ring.

Rule. Add the thickness of the ring and the inner diameter together, multiply by the square of the thickness, and finally by 2·4674: the result is the solid contents.

Example. A large iron ring on measurement was found to be two inches in thickness, and the inner diameter 16 inches: required the solidity.

Here $2 + 16 \times 4 = 18 \times 4 = 72$

Then 2·4674
72
49348
172718
177·6528

Ans. 177·6528 feet.

Prob. XVIII. To find the solid contents of a cylinder.

Rule. Multiply the area of the base by the perpendicular height: the product will be the solidity.

Example. A pillar just 12 feet high, has a diameter of 20 inches: required the solid contents in inches.

By Prob. XV. $20^2 \times \cdot7854 = 400 \times \cdot7854 = 314\cdot1600$.

And 314·1600
144
12566400
12566400
3141600
45239·0400

Ans. 45239·0400 inches.

Prob. XIX. To find the solid contents of a cone.

Rule. Multiply the area of the base by the perpendicular height, and take one-third of the product.

Example. Required the solid contents of a cone, the diameter of whose base is 5 feet, and height 22 feet.

By Prob. XV. $5^2 \times \cdot7854 = 25 \times \cdot7854 = 19\cdot6350$.

Then 19·6350
22
392700
392700
3) 431·9700
143·9900

Ans. 143·9900 feet.

(I.)

Prob. XX. To find the area of an ellipse.

Rule. Multiply the two diameters together, and their product by ·7854: the result is the required area.

Example. An elliptical looking glass was found on measurement to be 4 feet 6 inches by 3 feet 6 inches: required the area.

```
                feet.
Here          4·5
              3·5
            ------
              225
             135
            ------
             1575
             ·7854
            ------
             6300
            7875
           12600
          11025
          ---------
          12·370050
                12
          ---------
           4·440600
                12
          ---------
          5·287200
```

Ans. 12 feet 4 inches 5 pa. +

(K.)

1. In representing the ovolo accurately, the point of the compass should be placed in a.; a. b. taken as a radius, and the curve b. c. be drawn.

2. The centre of the curve in the cavetto should be outside equi-distant from b. and c.

3. In forming a cima recta the line a. b. should be drawn and divided into two equal parts; the centre of the arcs can easily be calculated.

4. The centre for the arc in the torus is at E.

(L.)

Prob. XXI. To find the height of a Tuscan column when the diameter is given.

Rule. Multiply the diameter of the column by 7: the quotient will be the height.

Example. A Tuscan column was found to measure 1 foot 8½ inches at its base: required its height.

	ft.	in.
Here	1	8½
		7
	11	11½

Ans. 11 feet 11½ inches.

Prob. XXII. To find the diameter when the height is given.

Rule. Divide the height of the column by 7: the quotient will be the diameter.

Example. A Tuscan column is 24 ft. 6 in. in height: required its diameter.

	ft.	in.
7)	24	6
	3	6

Ans. 3 feet 6 inches.

HINTS ON THE INTRODUCTION OF A COURSE OF DRAWING IN A SCHOOL.

It has been already stated that the children in the schools in the Borough Road, after being fully qualified, by assiduity and perseverance, to follow the directions of their teacher, as contained in the preceding lessons, are then conducted to other classes, where opportunities are afforded for a more extended course of study.

A few hints are appended on the best method of conducting such classes, with the materials used by the pupils.

The children studying drawing are divided into two departments—sections A and B; those in the former, consisting of mere beginners, are confined exclusively to the use of chalk and slate pencil; the advanced pupils use paper, with or without mathematical instruments.

Section A includes five classes, at each of which subdivisions the boys spend sufficient time to master the difficulties presented to them. The five classes are as follows:

1. Lineal.
2. Geometrical.
3. Map.
4. Natural objects, including animals, flowers, &c.
5. Architectural and mechanical.

1. *Lineal drawing.*—The pupils in this class pursue the preceding course, combined with the lessons in the Appendix, when their attainments and mental capacity permit. The monitor should be provided with ruler and compass, to test the accuracy of the sketches. He should be a tolerable draughtsman, so that his corrections may be made with truth. This class is considered introductory to the model drawing.

2. *Practical geometry* is another elementary course of the greatest service, and forms a good introduction to a series of lessons in mathematical drawing. Unlike the class

previously mentioned, the pupils are here provided with compass and square, and their problems are worked on large slates. The monitor is provided with a course of problems, chiefly selected from the works of Bonnycastle and Paisley; he first reads the problem, and in the course of its being worked a constant series of questions are put, that the pupils may not only be fully acquainted *how* to solve a problem, but *why* each succeeding step should be made,—thus exercising their reasoning faculties. The instruments used are prepared and sold by the Society.

3. *Map-drawing.*—This is a course of outline sketching. A copy of the map is fixed before the pupil's eye, who is required with his chalk to make a tolerably correct representation. The peculiar excellence of this study is the great assistance it renders the pupil in the acquisition of geographical knowledge. The mass of the children in the elementary class are only competent to trace a mere outline; some, however, of the most advanced, may perhaps be able to add the principal rivers, or the situation of the most important towns.

4. *Natural objects.*—This elementary class is preparatory to a more extended and finished course on paper. The copies presented are either animals, birds, flowers, shells, or in fact any object that may appear suitable. The main excellence of cultivating this is the perfect knowledge of the figure which a correct copyist must obtain. Care should be taken that the minutiæ and particular distinguishing characteristics of the animal or flower are accurately worked out. The only materials used are, as in the other elementary classes, chalk and black board.

5. *Architectural and mechanical.*—Without detracting from the merits of the preceding courses, the architectural class, in point of utility, unquestionably takes precedence.

The entire series consists of about eighty different

designs—such as roofs, entablatures, cornices, doors, &c.; the pupils are thoroughly grounded in a knowledge of each, with its parts and proportions. For accurate delineation, ruler, compass, and triangle are allowed in this class.

The time devoted to these several lessons never exceeds forty minutes in the day; and the pupil's stay in *each* class is limited to a fortnight, with the exception of the architectural course, where a month is very profitably spent.

Previous to the drafting off of the boys to the paper drawing, they are well examined as to their ability in making the whole of the representations above mentioned, and are also required to reply satisfactorily to the interrogatives of their teacher. This being done, they are introduced to

Section B.

The advanced pupils are subdivided into four classes, to which the five courses alluded to above are severally introductory.

1. *Model drawing.*—Dupuis' course of model drawing consists of about one hundred lessons; some of the pupils have passed through the entire course, and, on one occasion, received the encomium of Mr. Butler Williams, whose melancholy decease will ever be regretted by those whom he so materially assisted.

The system of object drawing proves of the greatest possible benefit to those children whose avocations in after life will be of a mechanical turn.

The suggestions in the "Manual of Model Drawing" are fully adopted, and, in proportion as the clear and concise rules therein contained are adhered to, so will success attend the teacher's exertions.

Much interest is excited by the occasional introduction of some simple familiar objects, either to relieve the more diffi-

cult lessons, or to apply those principles which are involved in the delineation of the models: such objects as a chair, a table, or a hat, will interest the pupil, and, at the same time, test his ability in a practical way.

It is worthy of remark, that some of those children who have made progress in this class have thereby been introduced into situations where their attainments have been received in lieu of a premium.

The theory and practice of perspective should necessarily accompany the introduction of the series of models. The excellent little treatise by Mr. Chambers may give a few hints on the subject; and, for further study, the work by Dr. Brooke Taylor is recommended.

The time devoted by the children to this class is forty minutes daily; the whole of which time they are under constant supervision, and every fault or inaccuracy pointed out and corrected.

I have found a constant explication of the lines of construction, in the whole set of models, highly beneficial to the student, not merely in improving the correctness of his drawing, but also to exercise thought. It is much to be regretted, that there is no course of instruction published in which these are contained.

2. *Map drawing.*—To this class the outline sketching mentioned in section A is introductory.

The drawings produced are usually highly finished. Here, also, the pupil's knowledge of geography is materially increased, as he marks the divisions into provinces, counties, or departments, placing the towns and rivers in their correct positions. This very finished drawing I consider to be a fine mental exercise, habituating the child to a concentration of his mind on his work. The maps are drawn both with and without the meridians: for the study of geography it may be desirable to retain them, but for mere drawing they

may be omitted, that the pupil may depend entirely on the cultivation of his eye. The best copies for map drawing are those published by the Society for the Diffusion of Useful Knowledge. The materials used are pen and Indian ink: the map is first accurately drawn with pencil, and, when correctness is shown in proportion and every other particular, the pen is carried over the pencilled lines with as light a hand as possible; the rest is then filled in, the border more accurately marked, and a succession of lines added to distinguish the coast. In some cases the maps are coloured: the colour should be laid on with the greatest care, and only of sufficient consistency to *tint* the groundwork. When this coat is perfectly dry, the outlines of each province or state may be more distinctly marked with darker colour than the interior. Too much care can scarcely be paid to these directions, as young persons are usually very fond of high colouring.

For large maps, particularly those designed to illustrate collective lessons in geography, the children may use crayons: but, with these comparatively coarse materials, the specimens produced will be far less finished than those executed with the pen.

3. *Drawing of natural objects*, (to which class 4, section B, is introductory,) receives considerable attention. The plates published by the Christian Knowledge Society, engraved by Mr. Whimper, with several series obtained from different sources, are here used. The materials employed are either pen, crayon, or colour: the results attending the introduction of this course have been in many cases very encouraging. The exquisite specimens of pen and ink drawing produced in some public schools have been so frequently witnessed, as scarcely to require allusion. The work, in some cases, is handled in so masterly a manner, that it resembles more closely an etching of considerable merit, than

a drawing. Landscapes are copied in like manner with great success.

The crayon is also employed in this class for drawings that require less finish.

Some of the leisure time of the children is devoted to such studies as the exquisite heads or designs by Jullien, as well as to flower painting: for the former there is no distinct class, as such drawing is deemed by many to rank more as an accomplishment than an exercise with a practical benefit; the latter is cultivated, for the same reason, to a very slight extent, attention being only given to it in class hours, when the pupil is qualified to copy from the flowers themselves, arranging them into groups according to his taste.

4. *Mechanical and architectural drawing.*—To this course classes 1 and 2, section A, may be considered introductory. The models and copies for the pupils here are of every description: plans and elevations of buildings, sections of engines or machines, or the five orders of architecture.

A case of mathematical instruments, with a stretching board for the paper, are indispensable for the pupils of this class. The drawings may either be left in outline or coloured. For representations of steam engines, or sections of machinery of every description, sepia or Indian ink may be employed for the shading with very good effect.

Many circumstances will oblige the course, of which the above is a brief outline, to be varied. The limited time, and still more limited resources available for the cultivation of drawing, may cause discouragement; but it will be found in this, as in every other case, that in proportion as the work is set about heartily, and proceeded with with spirit, so may results be looked for really beneficial to the pupil, and, at the same time, satisfactory to the teacher.

London: J. Rider, Printer, 14, Bartholomew Close.